REMARKS

Reconsideration and allowance of this application, as amended, are respectfully requested.

Drawings

Applicant agrees to the drawing changes recommended by the Examiner. A substitute sheet of drawings is included with this response.

Claims

The prior art grounds of rejection are respectfully traversed. The claims are not amended at this time.

Applicant's understanding of the references differs from that of the Examiner in at least the following two respects.

(1) It appears that the Examiner regards Akiyama's "high concentration region 2A" as being equivalent to the "defect region" ; and

(2) It is incorrectly understood that all of the "low concentration regions 28" get depleted after a switch is turned off and only 2A remains as a non-depleted region.

As to point (1), in Aklyama et al., "high concentration region 2A" must be thicker than the "defect region" as described in reference column 15, lines 20-28:

> It is desirable that the N+ epitaxial layer 2A is thin to improve the efficiency of holes flowing in, but on the contrary, it is necessary to keep the N+ epitaxial layer 2A sufficiently thick because the crystal defects caused by the ion bombardment are locally produced in the N+ epitaxial layer 2A. Thus, the thickness of the n+ epitaxial layer 2A must be determined taking the above requirements into consideration.

Akiyama's "defect region" must not include the entirety of 2A (a part of non-depletion region). Therefore, the "high concentration region 2A" is not equivalent to the "defect region." On the other hand, our claimed "defect region" includes the entirety of the non-depleted region. Accordingly, our claimed inventions differ from Akiyama in this regard. Furthermore, in Akiyama, as described in column 14, lines 13 – 40:

As can be seen in FIG. 17, the trade-off relations between the turn-off time and the ON resistance are kept better in the case where the helium ions are bombarded into the N+ epitaxial layer 2A than in the case where they are bombarded into the N− epitaxial layer 2B. This is caused for the following reason: As shown in FIG. 12, the concentration of the N+ epitaxial layer 2A is sufficiently higher than that of the N− epitaxial layer 2B. This means that the resistance value of the N+ epitaxial layer 2A is sufficiently higher than that of the N− epitaxial layer 2B, and the increase in resistance component caused by the producing of the crystal defects can be ignored. Thus, although the conductivity modulation caused primarily in the N− epitaxial layer 2B when the IGBT is ON is somewhat impeded, the extent of the impediment can be reduced compared with the case where the crystal defects are caused directly in the N− epitaxial layer 2B.

Due to electrons flowing into the P+ collector layer 1 from the N base layer 2 at the beginning of the turn-off time, holes are liable to flow into the N base layer 2 from the P+ collector layer 1, and in order to rapidly catch the holes, it is convenient to cause the crystal defects collectively in the N+ epitaxial layer 2A in the closest proximity to the P+ collector layer 1. That goes similarly for the case where ions other than the helium ions, such as hydrogen ions and lithium ions, are bombarded.

the defect region should be arranged on high concentration region 2A rather than on low concentration region 2B. Further, the defect region preferably concentrates in the high concentration region 2A. That is, Akiyama teaches that the low concentration region 2B should NOT include the defect region. In this respect, our claimed inventions differ from Akiyama.

As to point (2), Akiyama does not teach that the entirety of low concentration region 2B gets totally depleted after the switch is turned off. As stated in our remarks in the Amendment filed October 31, 2002, it is apparent that the non-depletion region may remain in a part of the low concentration region 25 after the switch is turned off (even if this does not exactly coincide with Akiyama's figures). Thus, it appears that the Examiner may have misunderstood the Akiyama reference and based the rejections on that erroneous understanding.

In view of the above remarks, it is respectfully urged that the claims are patentable over the Akiyama et al. reference.

Respectfully submitted,
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